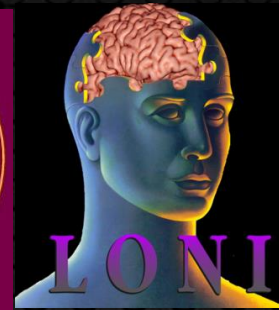
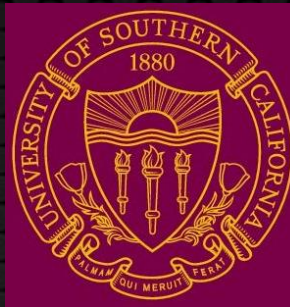
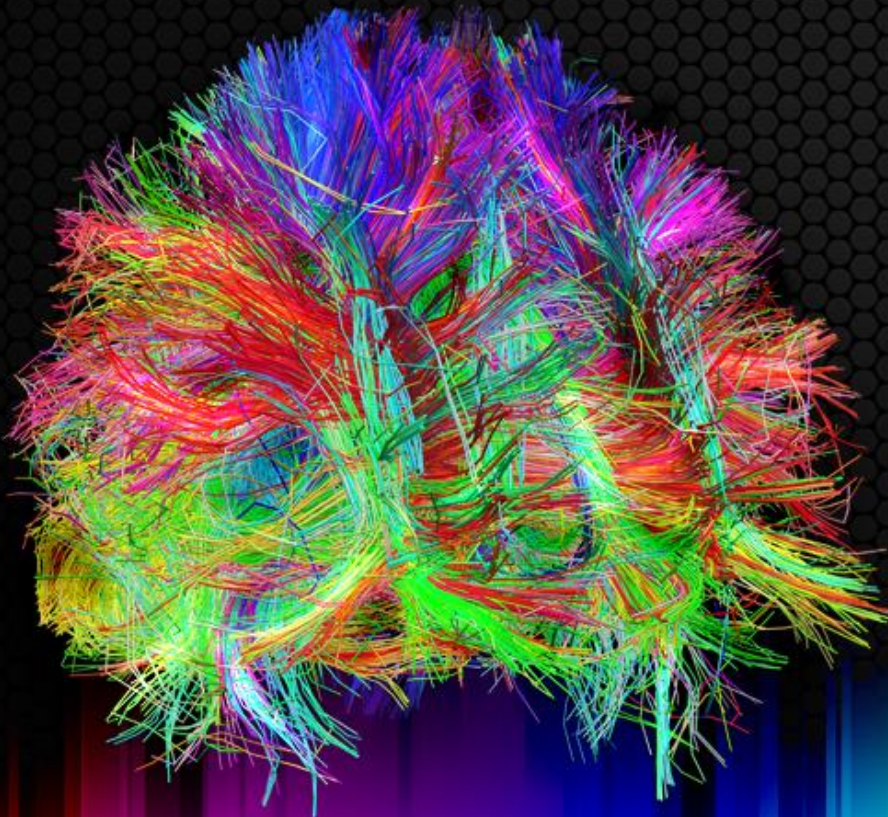


NA-MIC TBI DBP: Three Years of Progress in Modeling and Mapping Neurotrauma



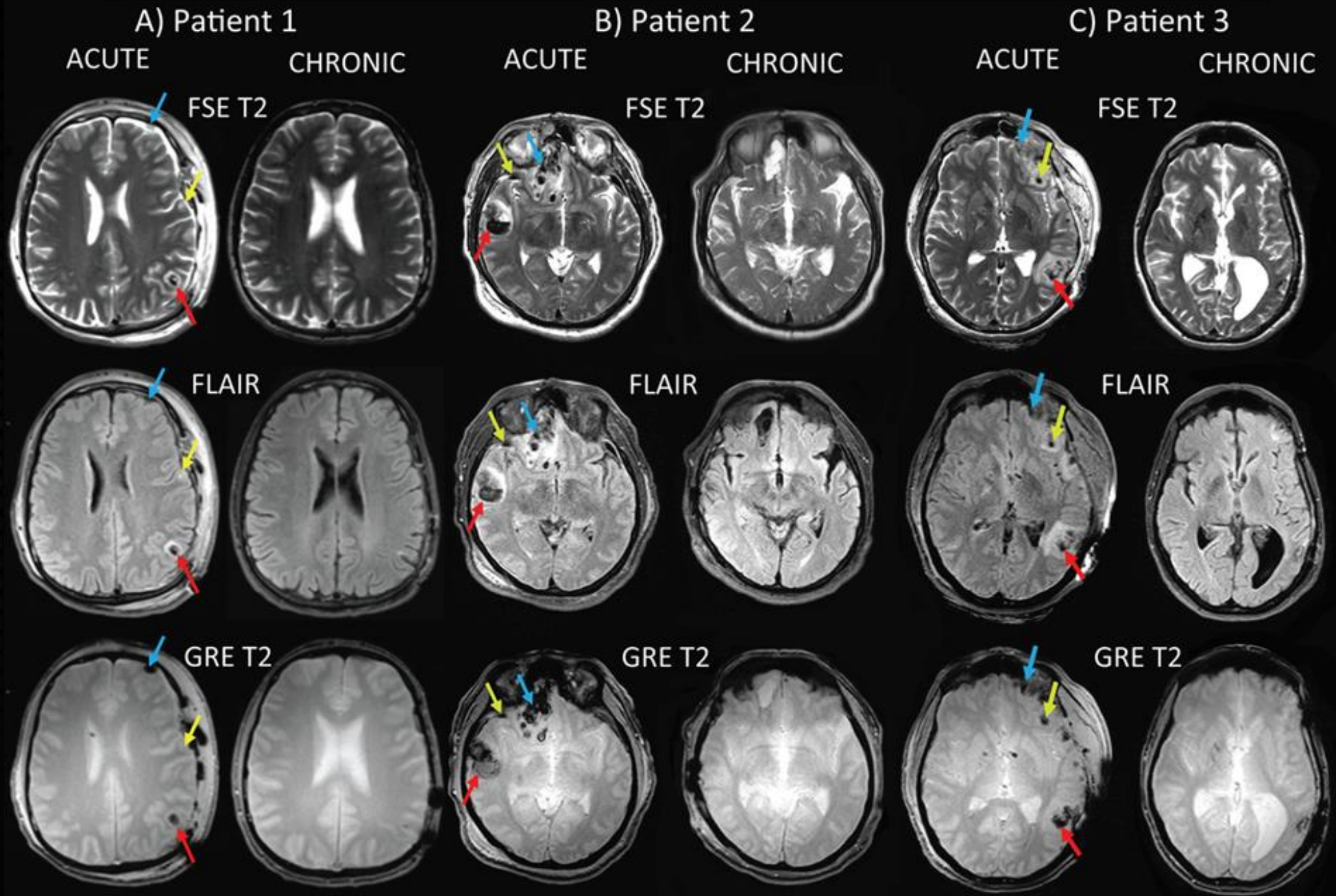
Keck
Medicine
of USC

John Darrell Van Horn, Ph.D.

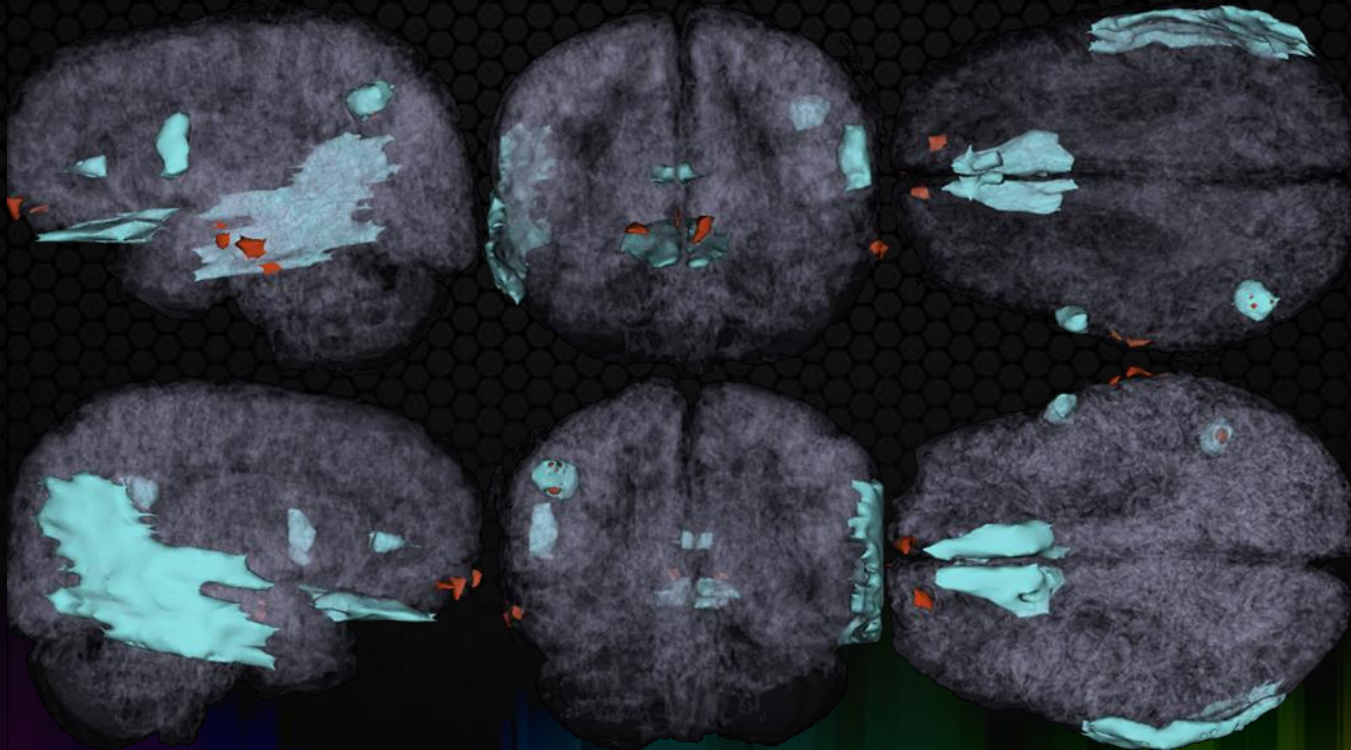
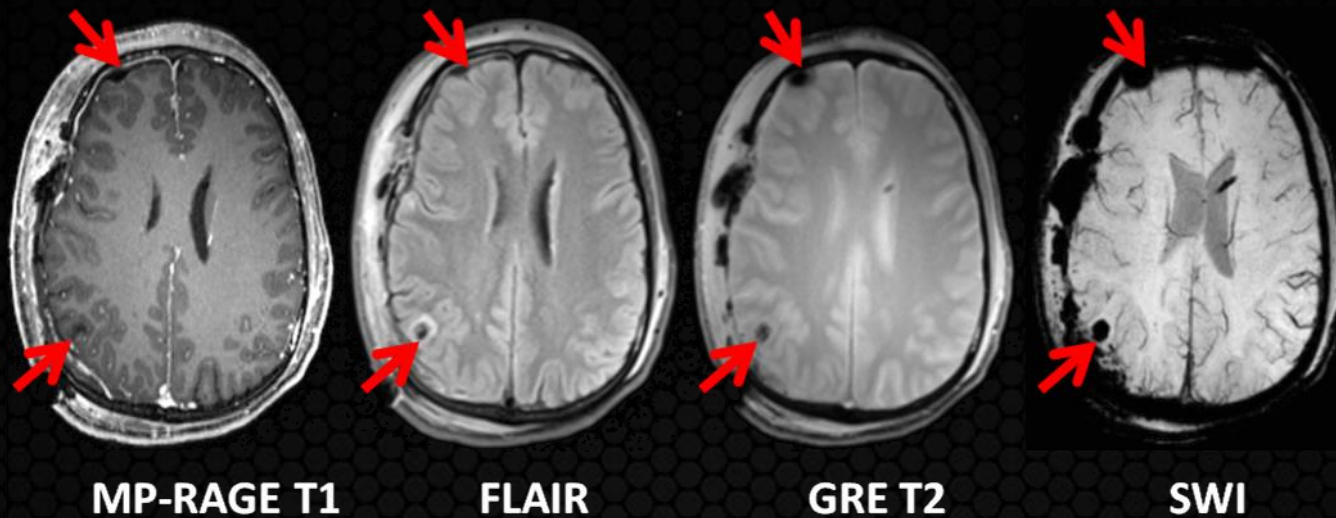
associate professor of neurology,
neuroscience, and engineering
Institute for Neuroimaging and Informatics
University of Southern California

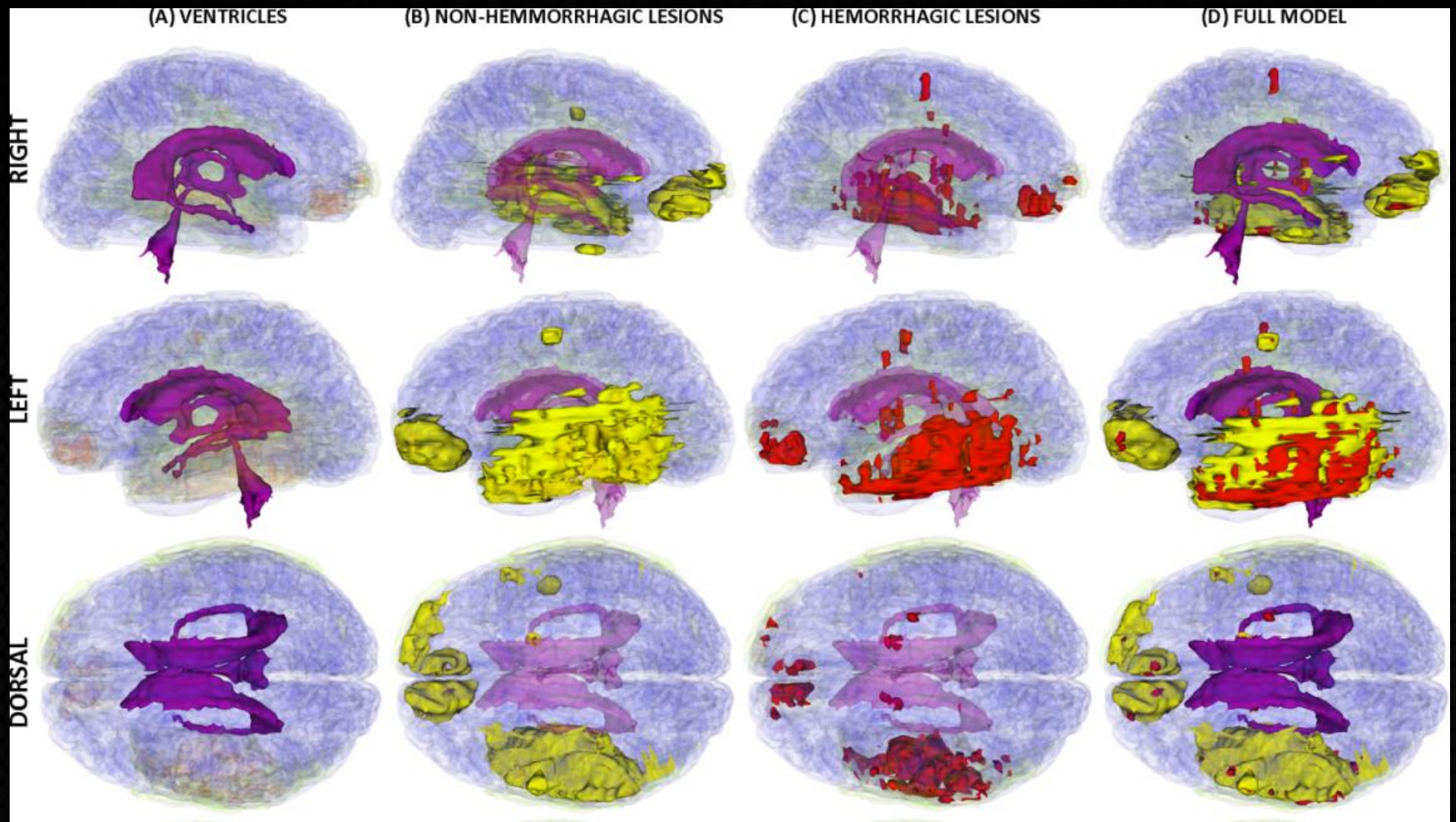
www.ini.usc.edu

Longitudinal neuroimaging of TBI

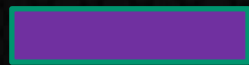


Multimodal neuroimaging approach





Acute



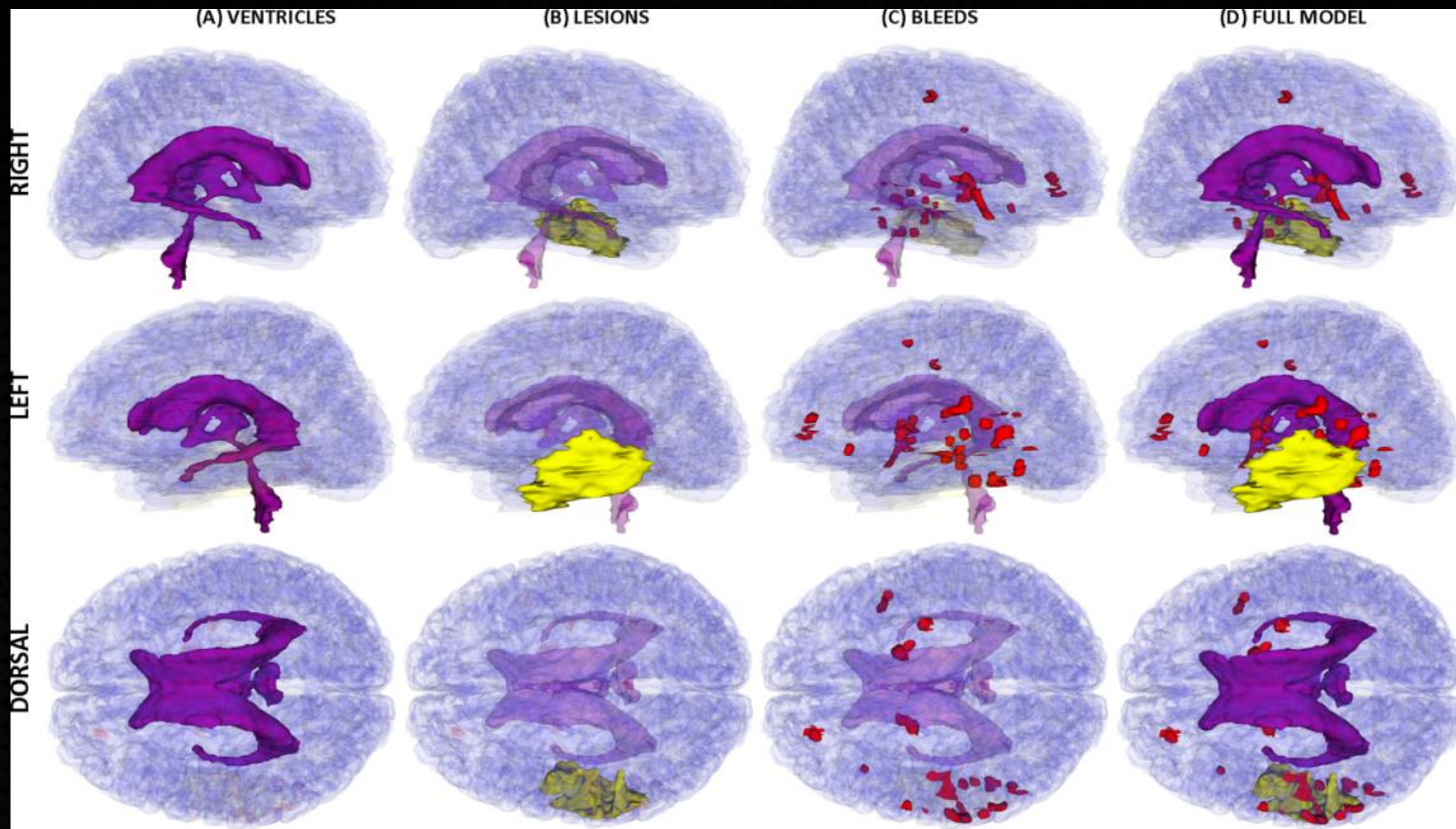
ventricular system



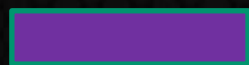
edema



hemorrhage



Chronic



ventricular system



edema

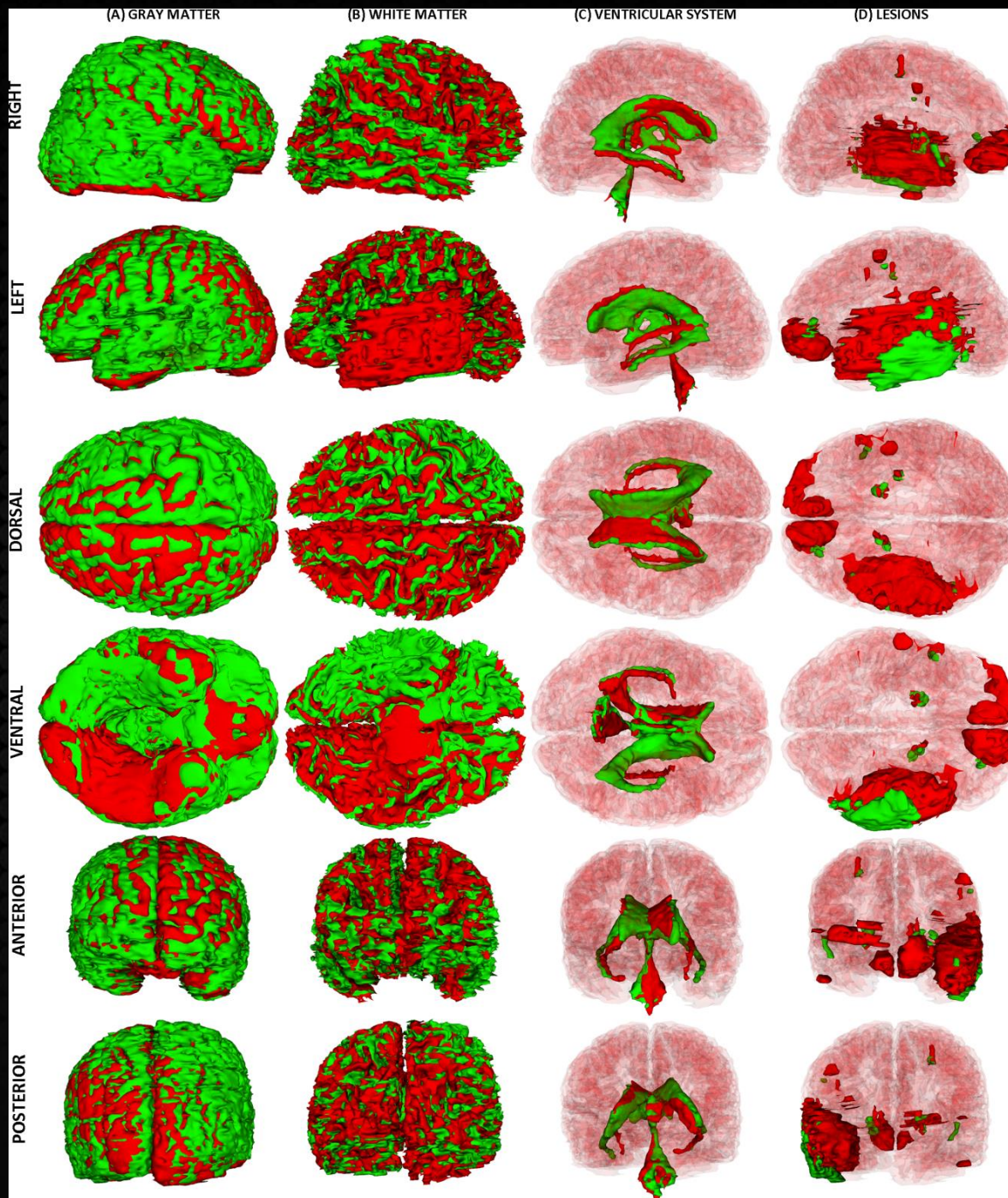


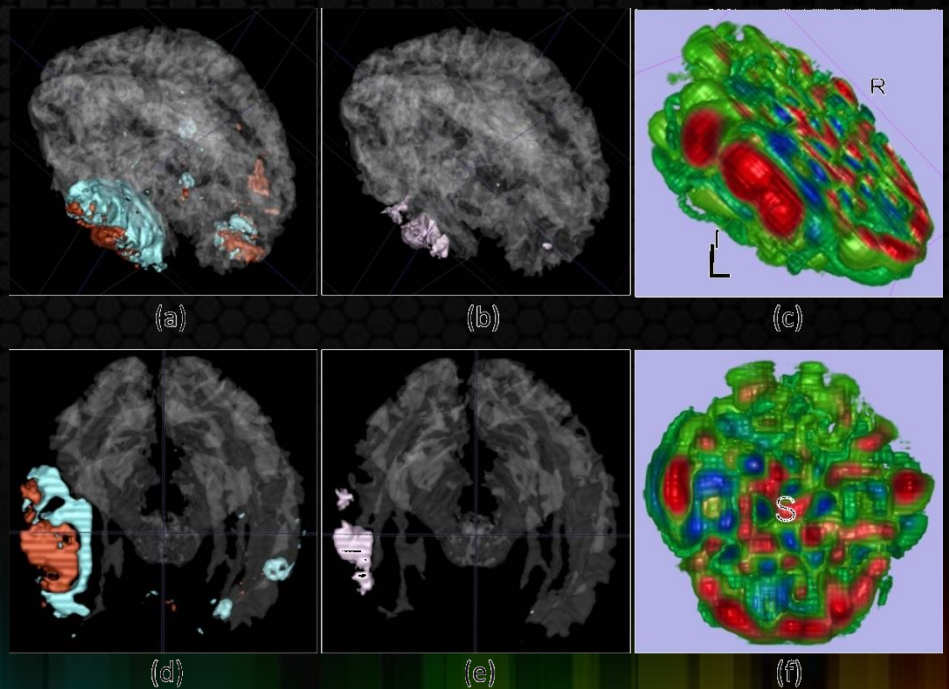
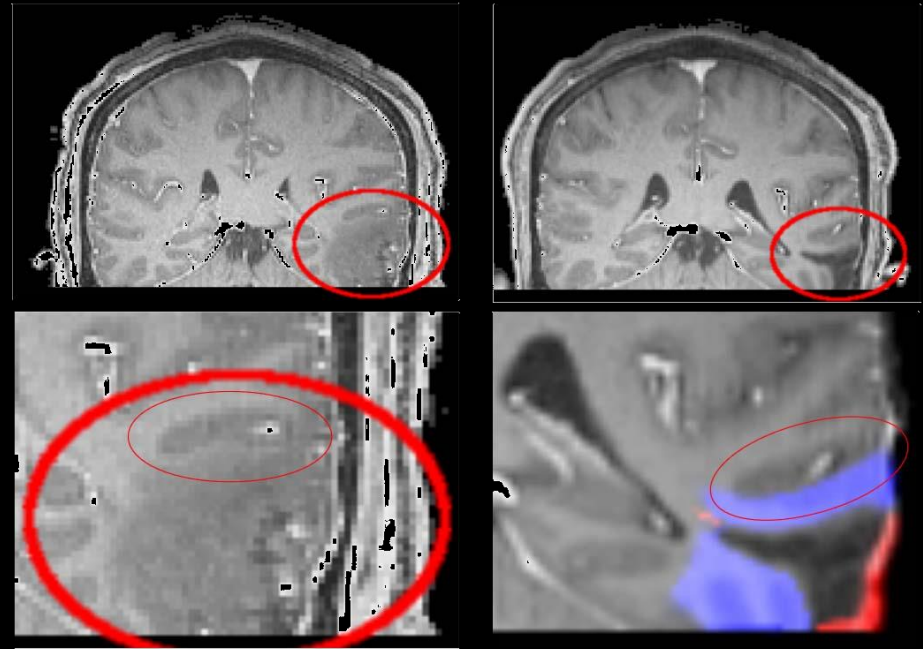
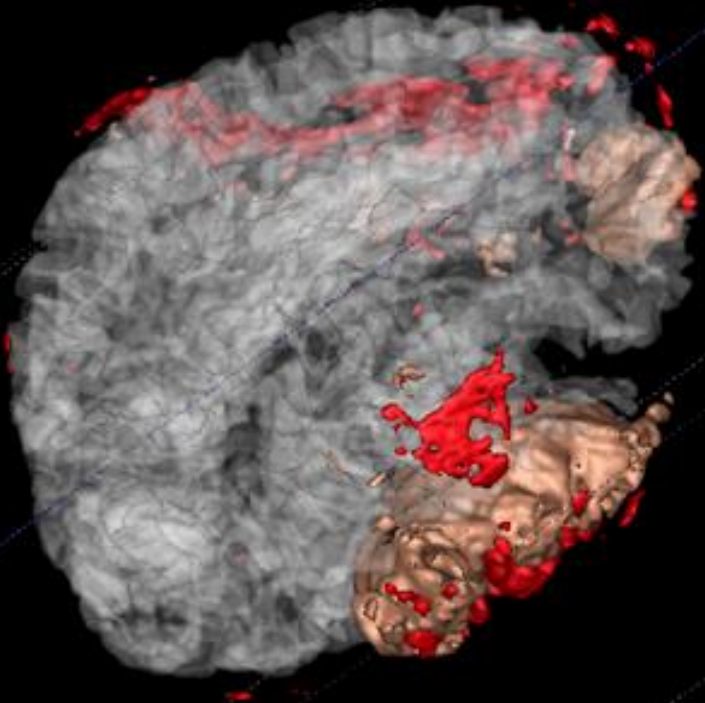
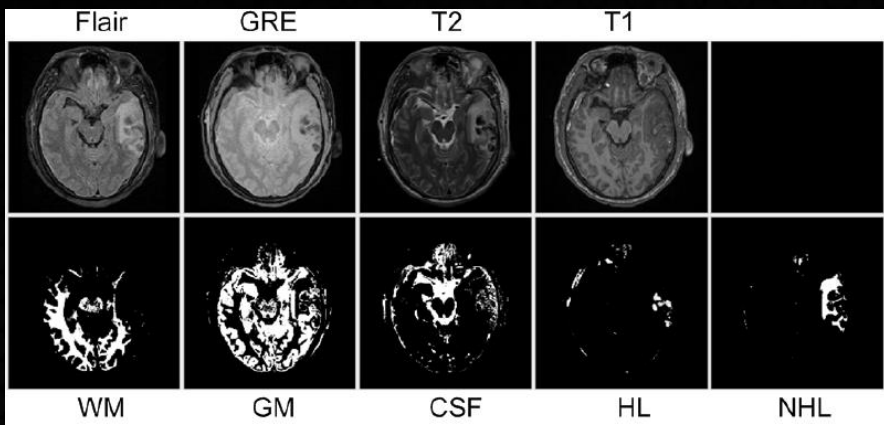
hemorrhage

Irimia et al. (2011) *Journal of Neurotrauma* vol. 28, p. 2287

longitudinal changes in brain shape

 acute
 chronic

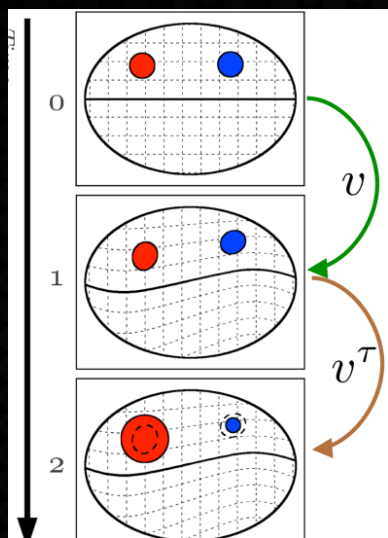




Wang, Niethammer, Gerig, Prastawa, and colleagues (2011-2013)

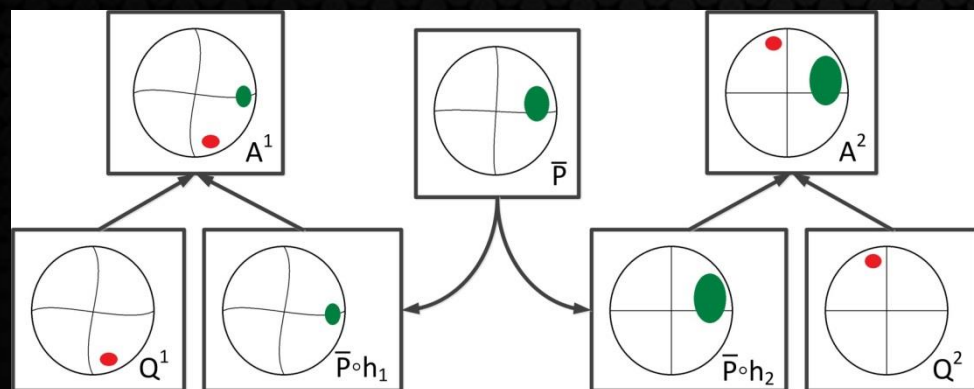
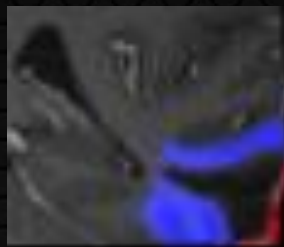
geometric metamorphosis

joint estimation of background
& pathology deformation



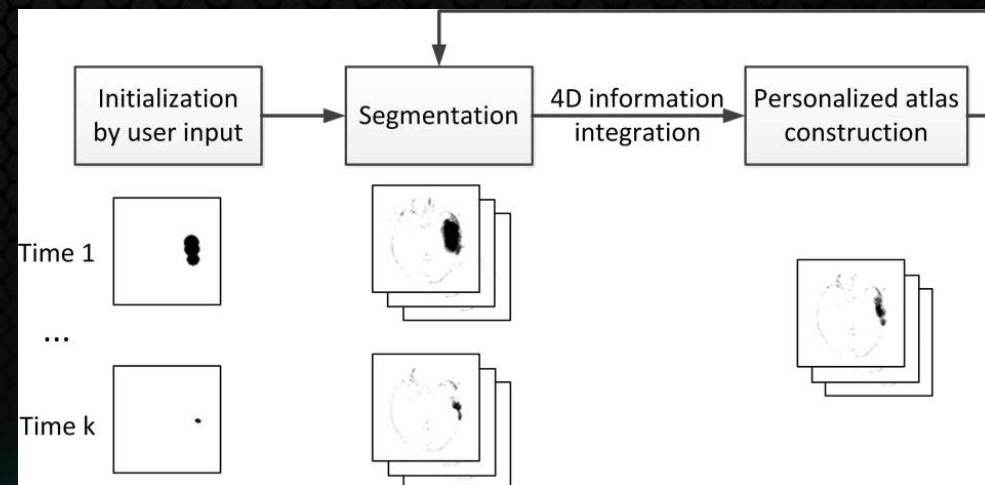
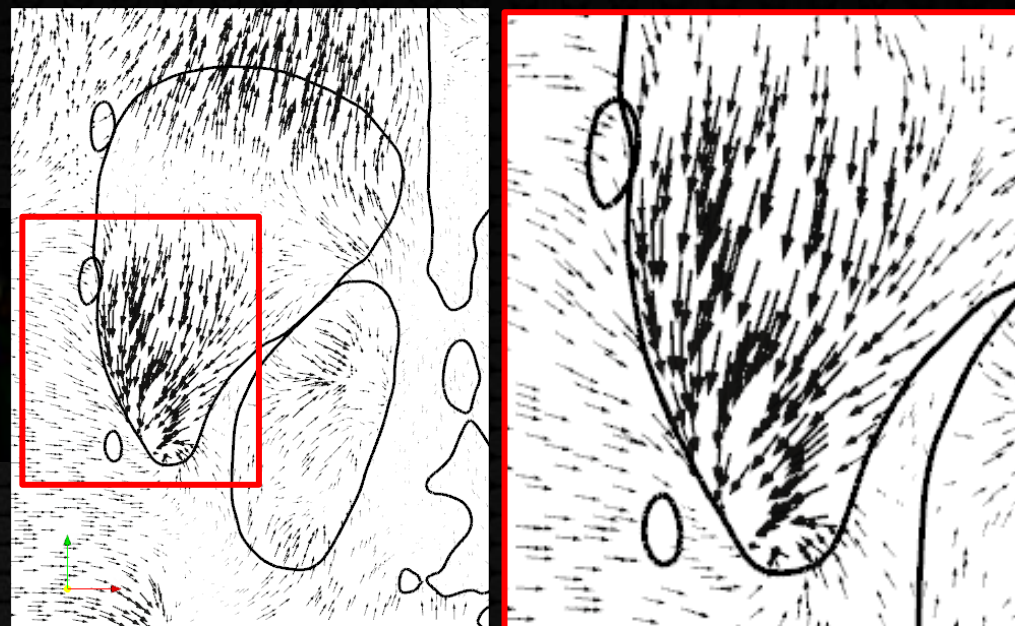
global
background
motion

pathology
grows or
contracts



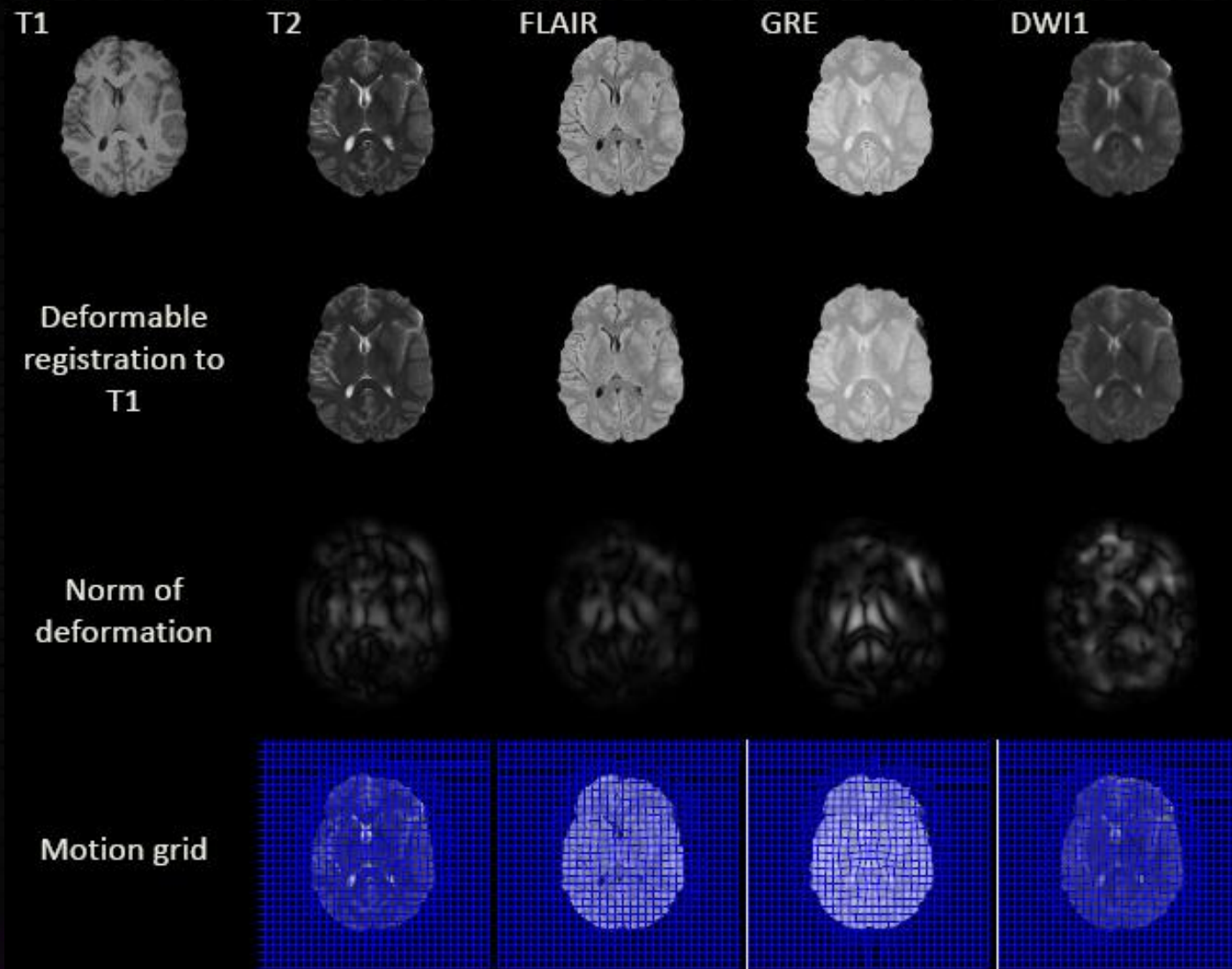
accounting for diffeomorphic
and non-diffeomorphic features

registration of sliding anatomical structures

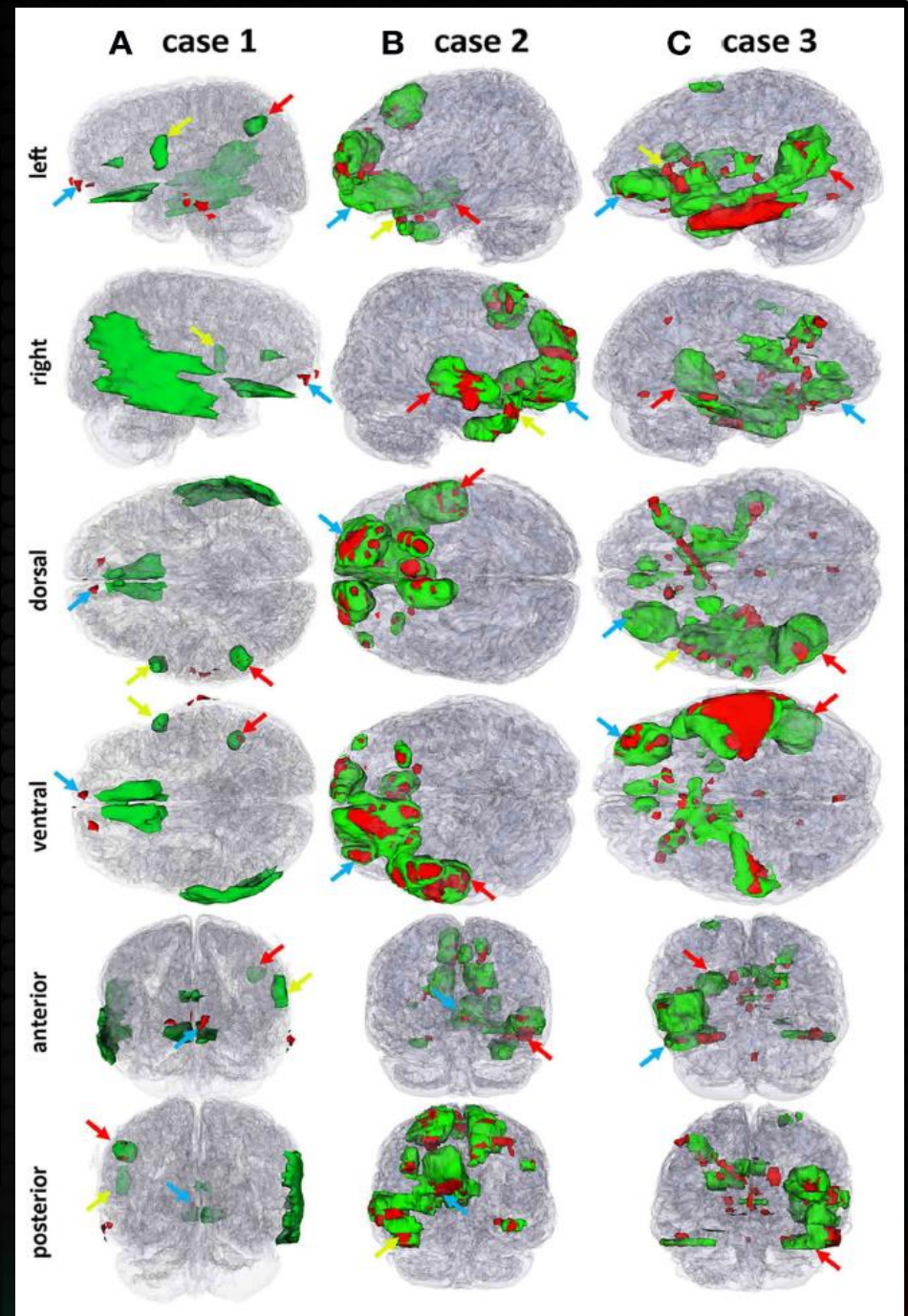
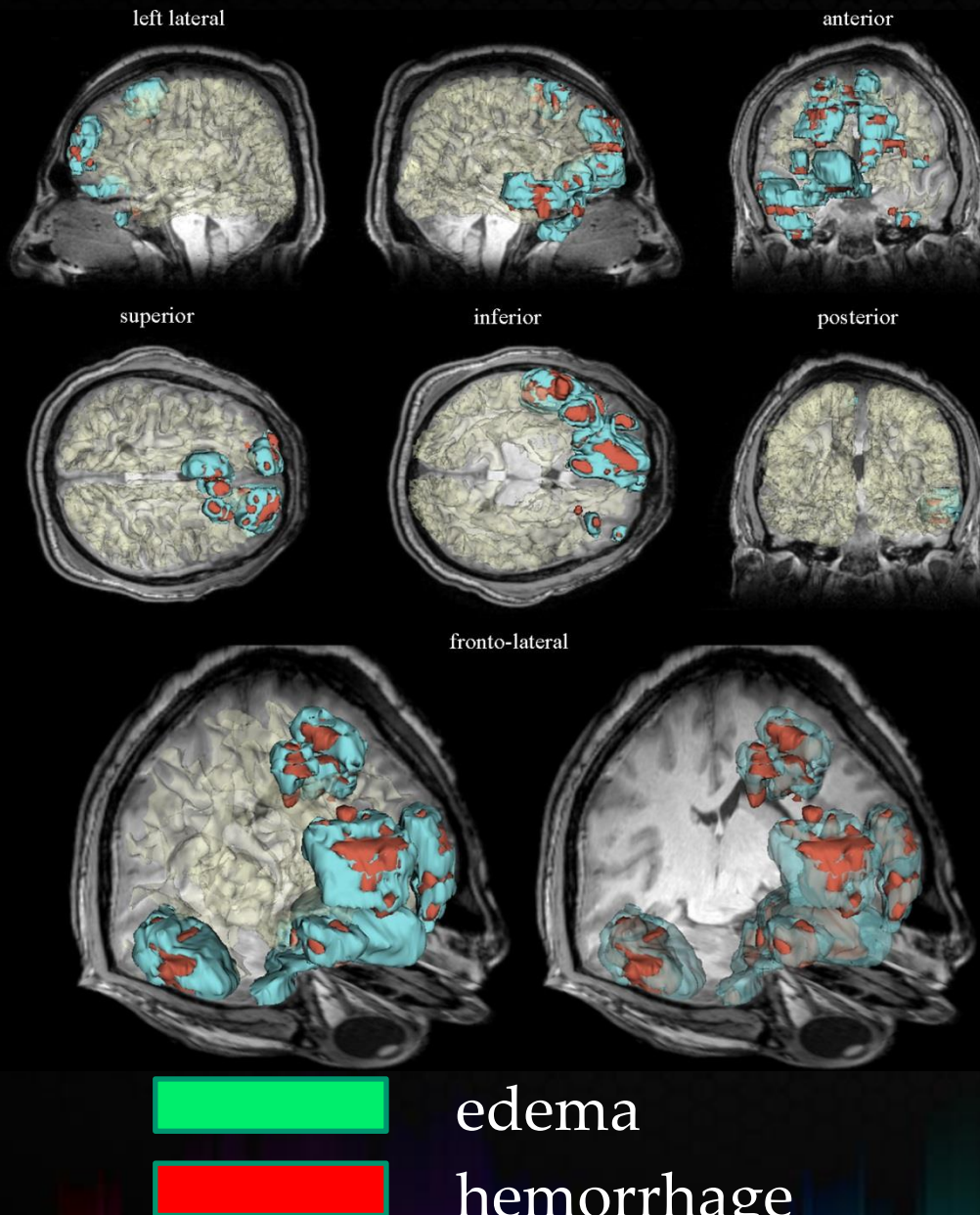


Niethammer, Aylward, et al.

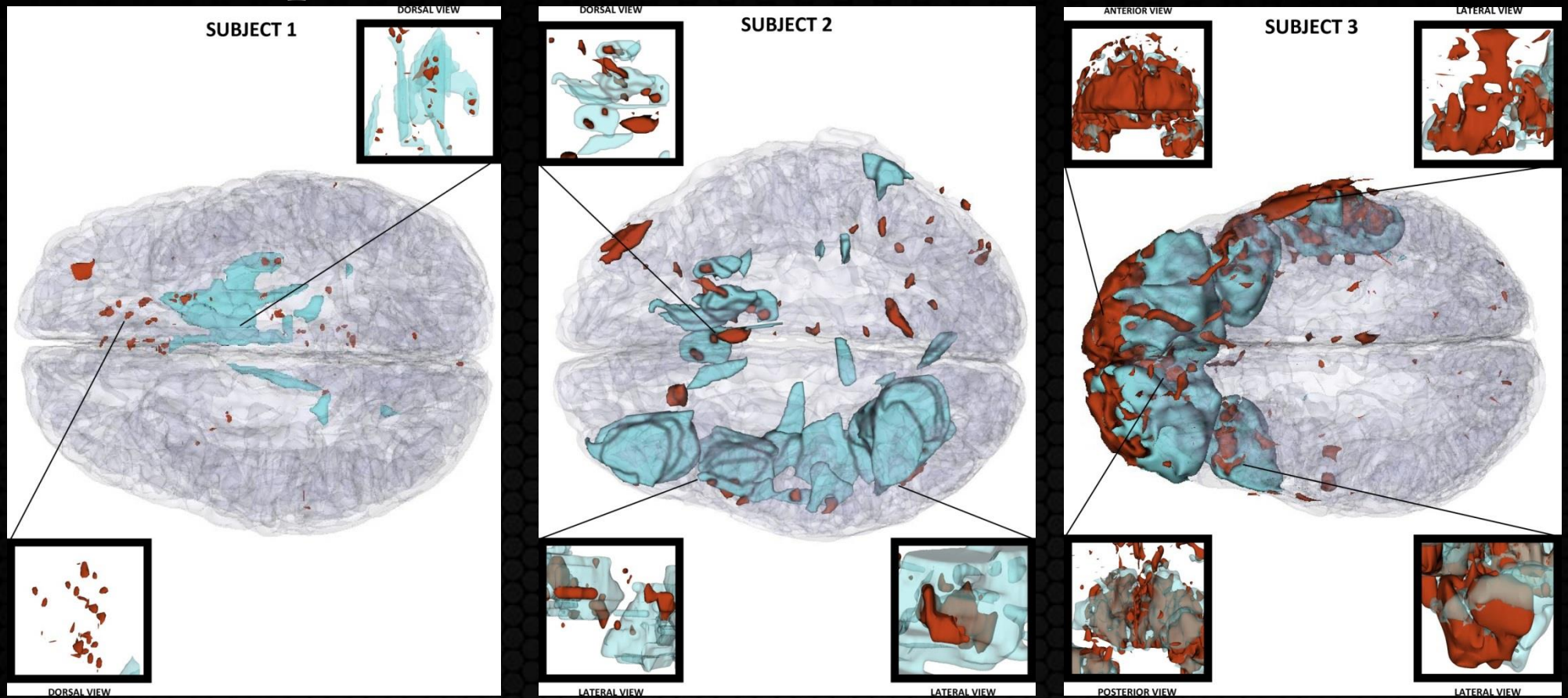
Multimodal Registration for TBI



pathology modeling

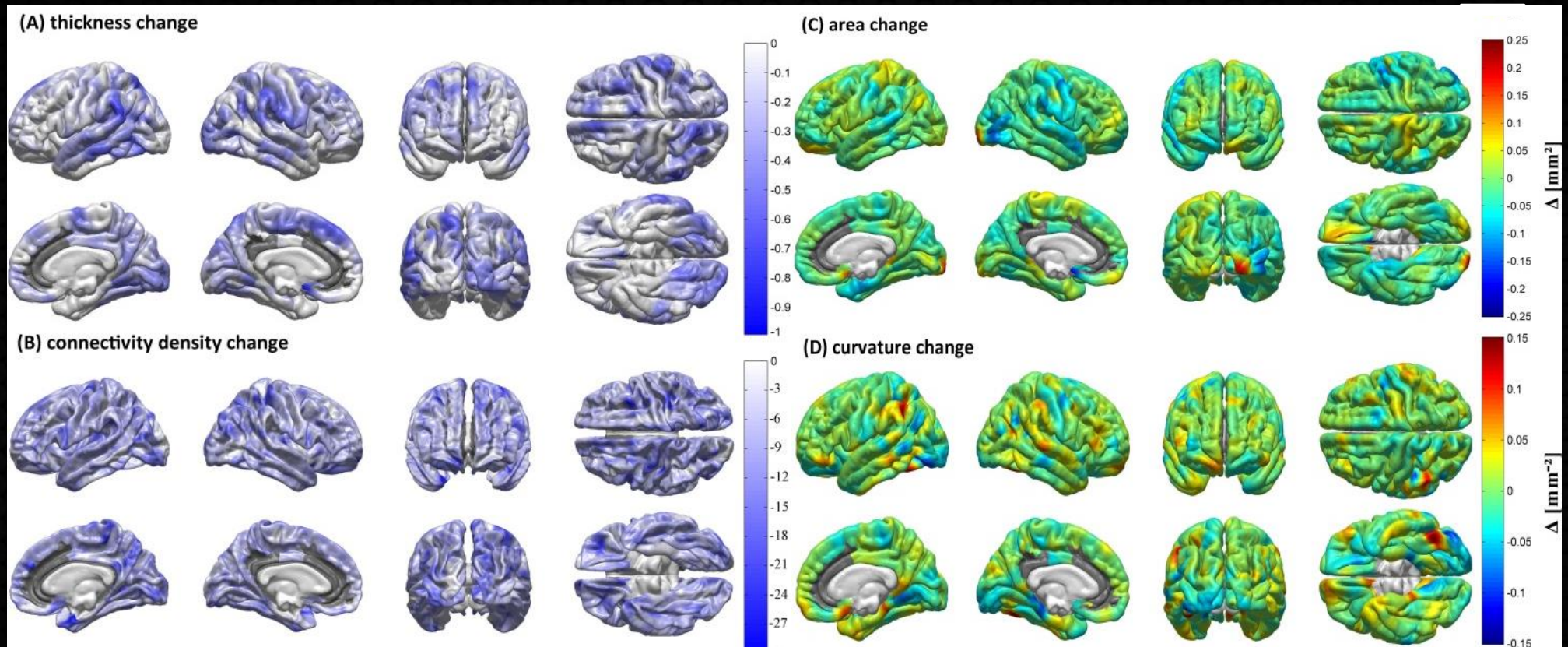


patient-tailored visualizations



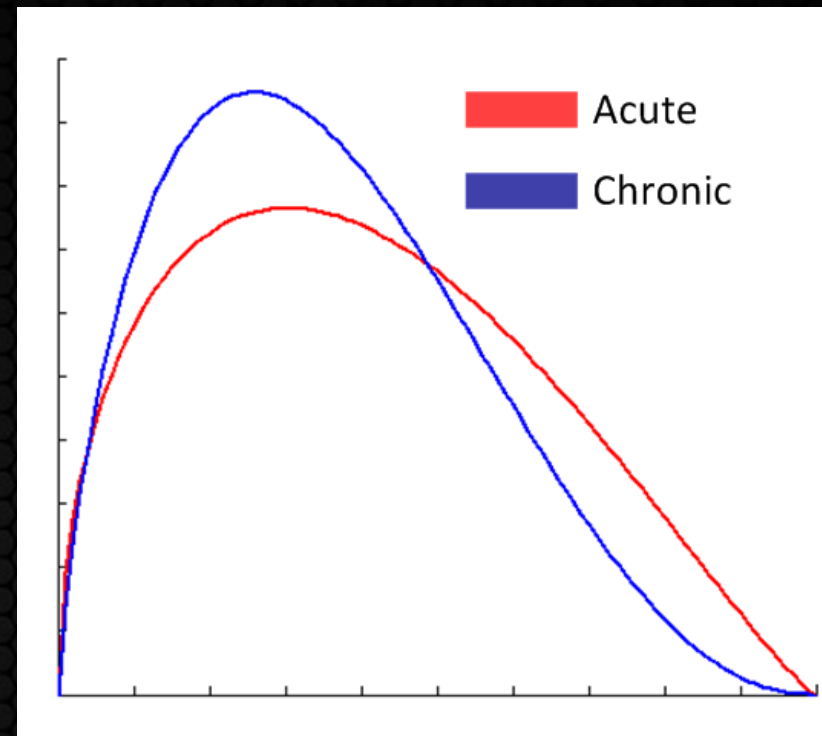
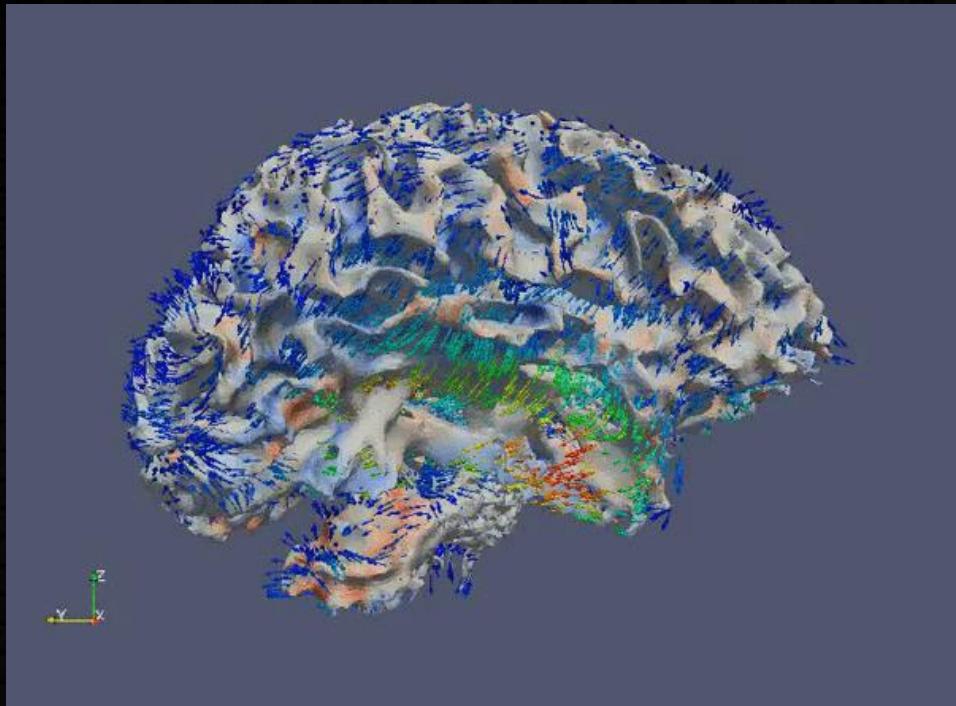
injury severity

Structural brain changes after TBI



substantial changes are observed even in healthy-appearing regions of the TBI brain

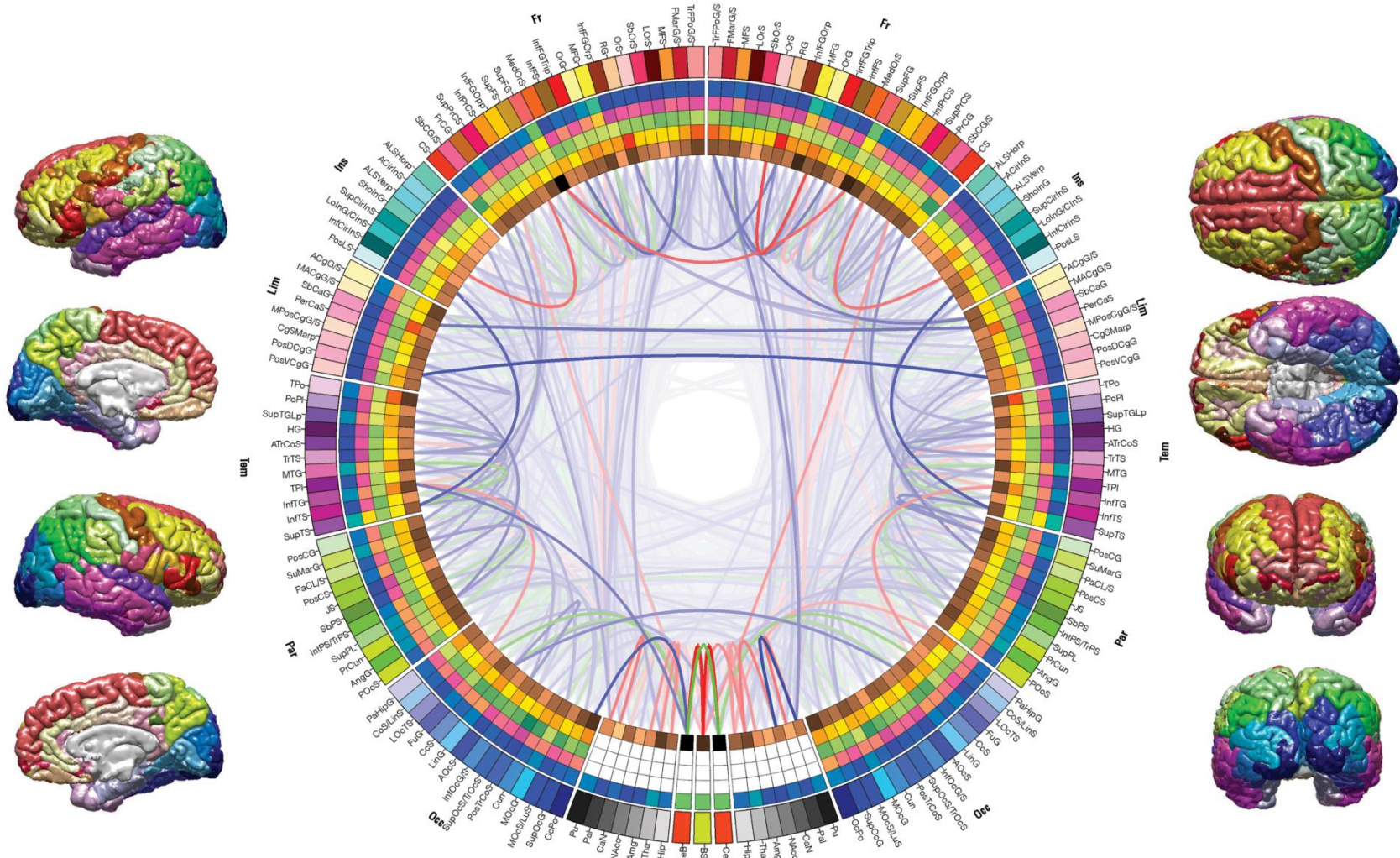
Time Dependent Changes in Cortical Thickness in TBI



Surface-based biomarkers shown for one subject:

- (a) Visualization of cortical thickness change and spatial displacement,
- (b) Cortical thickness distributions at acute and chronic time points.

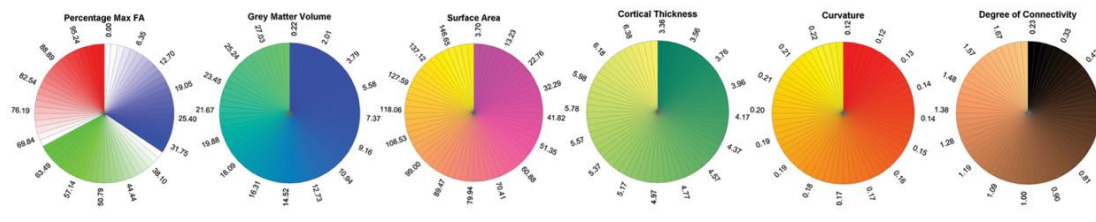
Illustrating cortical atrophic processes ongoing long after initial injury affect the entirety of the cortex including healthy appearing tissues



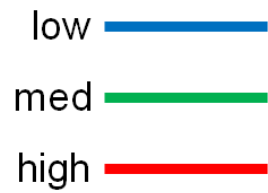
Sample Summary:

N=110
 right handed
 Healthy males
 25-36 years old

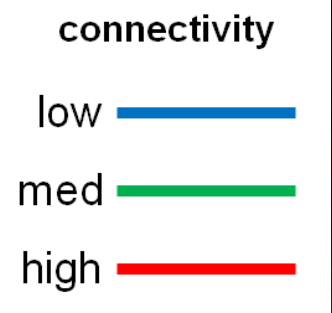
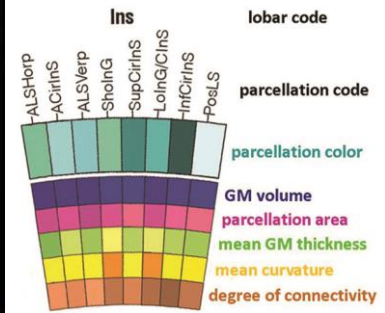
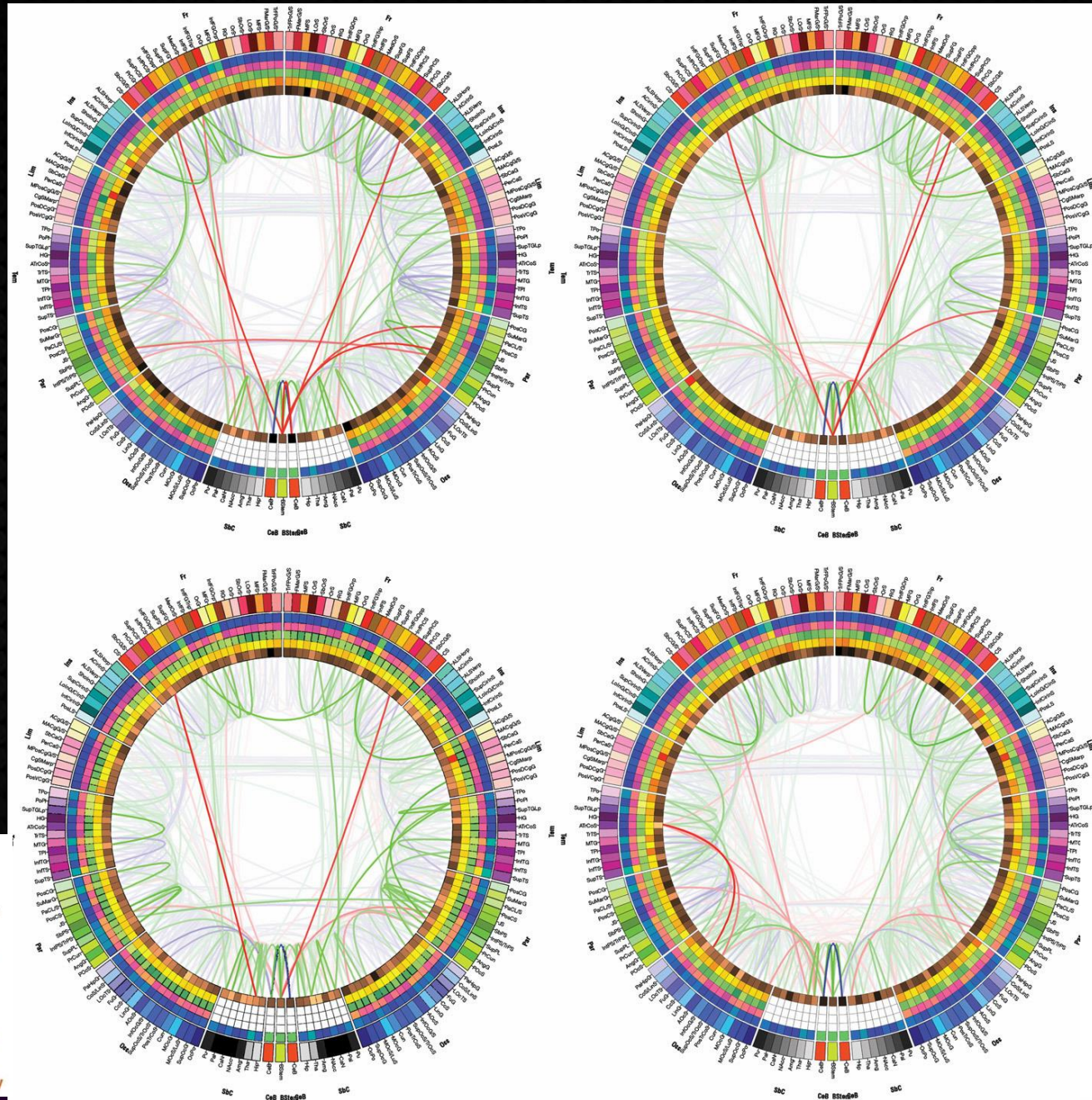
Sbc CaB BStefB Sbc



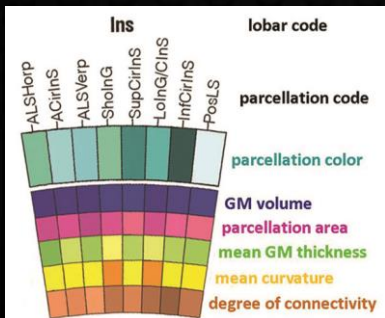
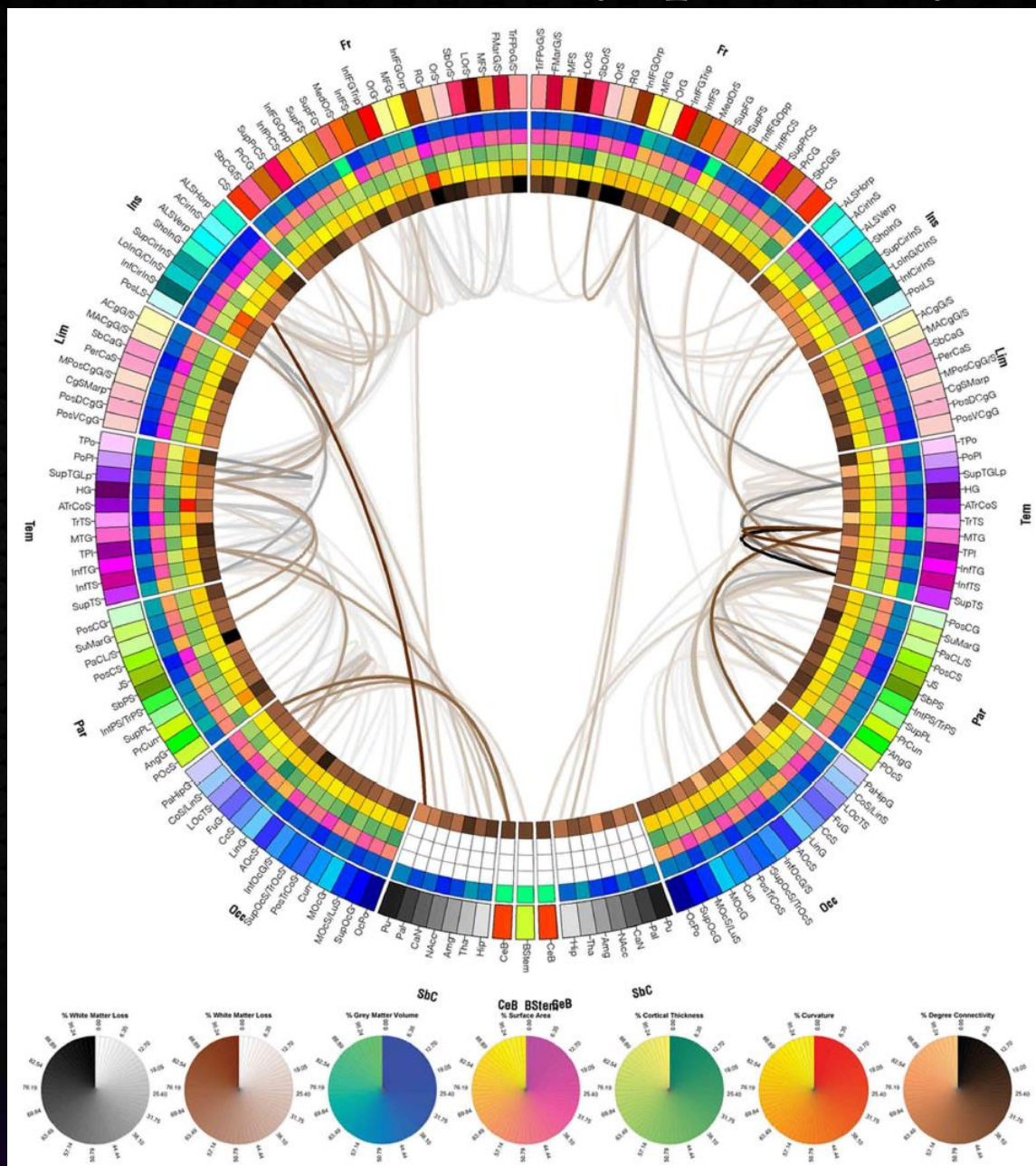
connectivity



Connectome Variability

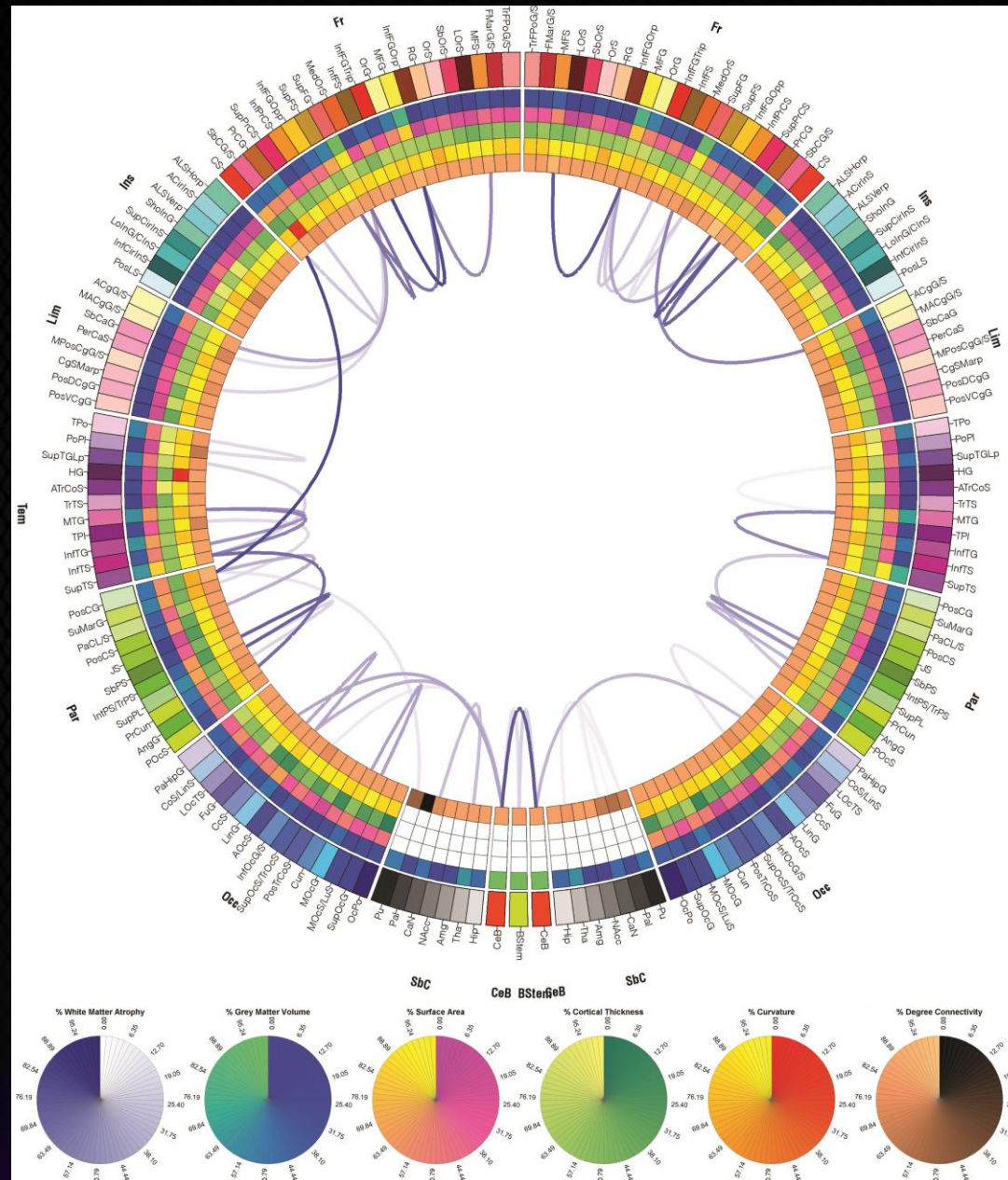


connections affected by primary injuries

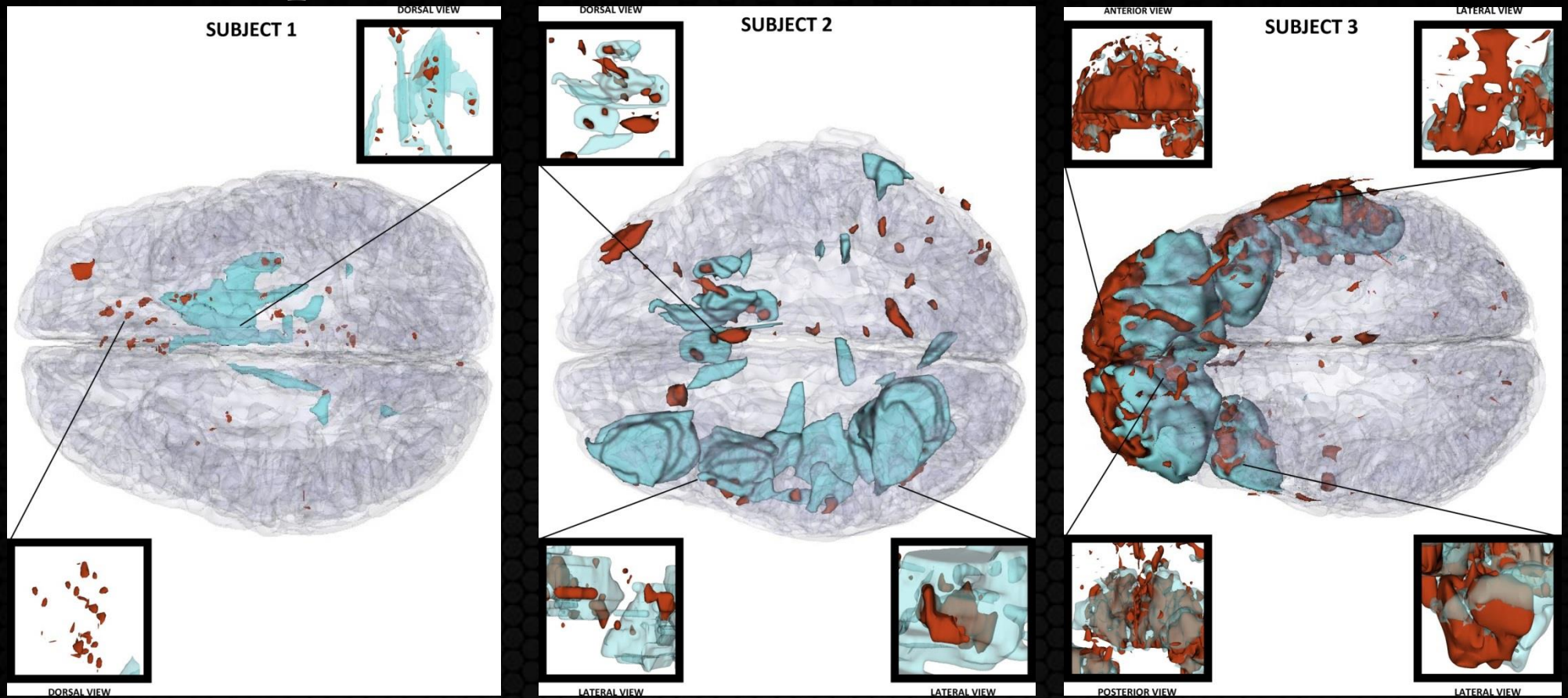


Irimia et al. (2012) *Frontiers in Neurology* vol. 3, article 1

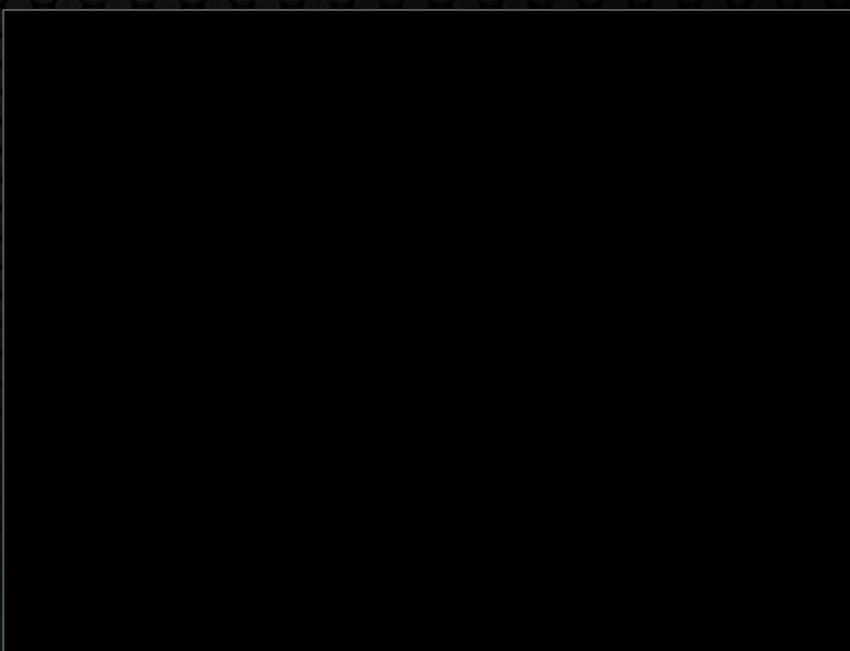
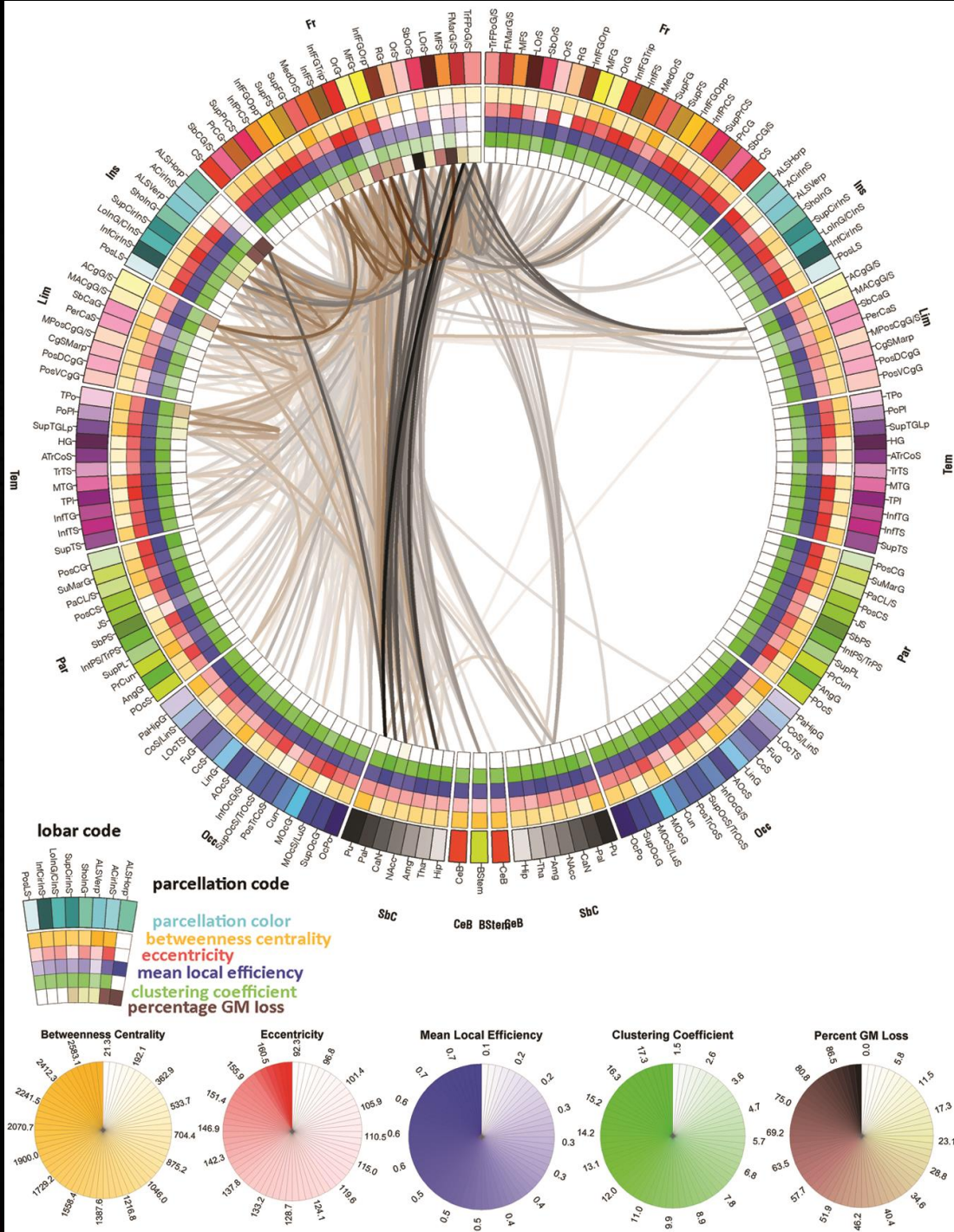
severely atrophied connections at 6 mo



patient-tailored visualizations

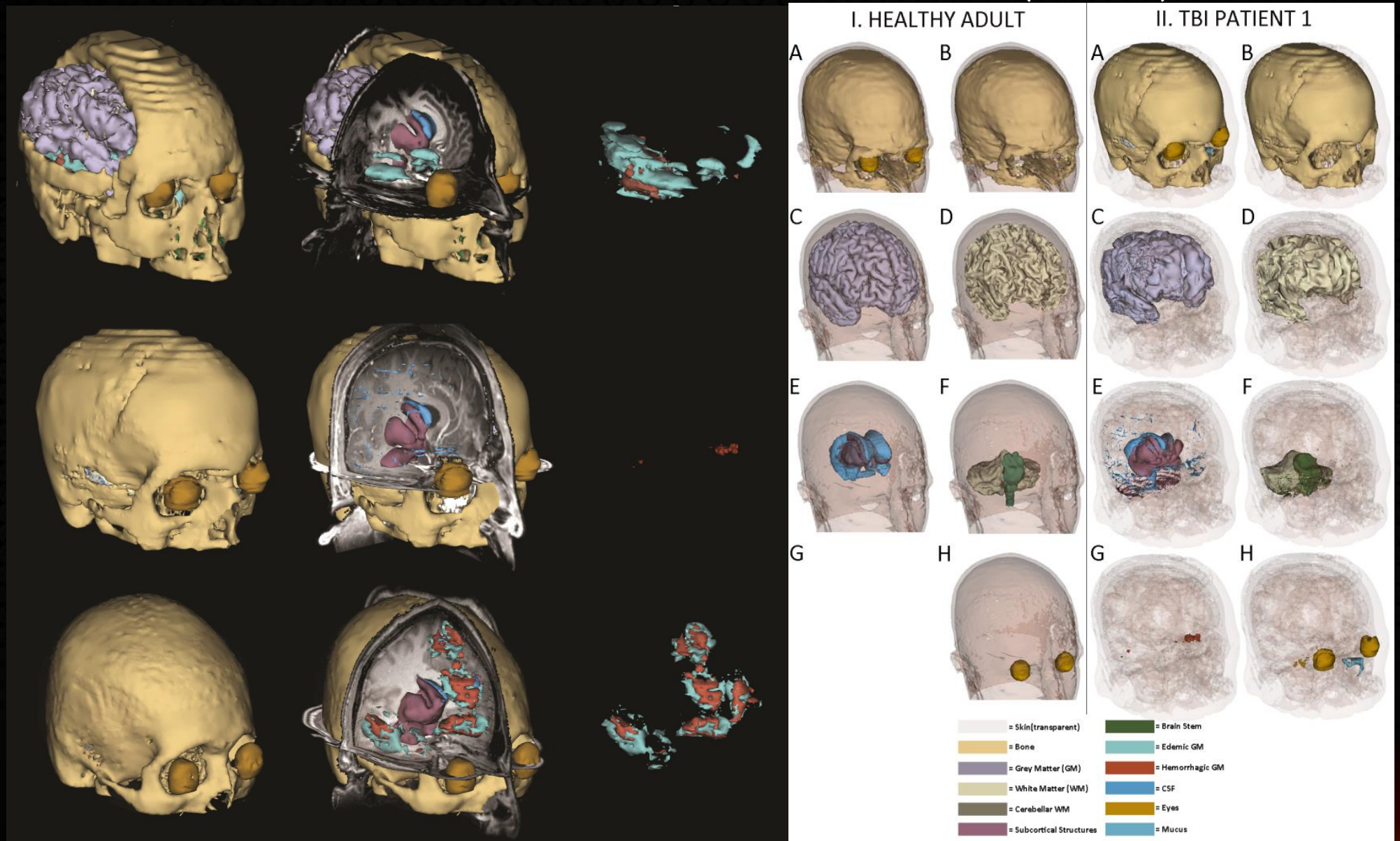


injury severity



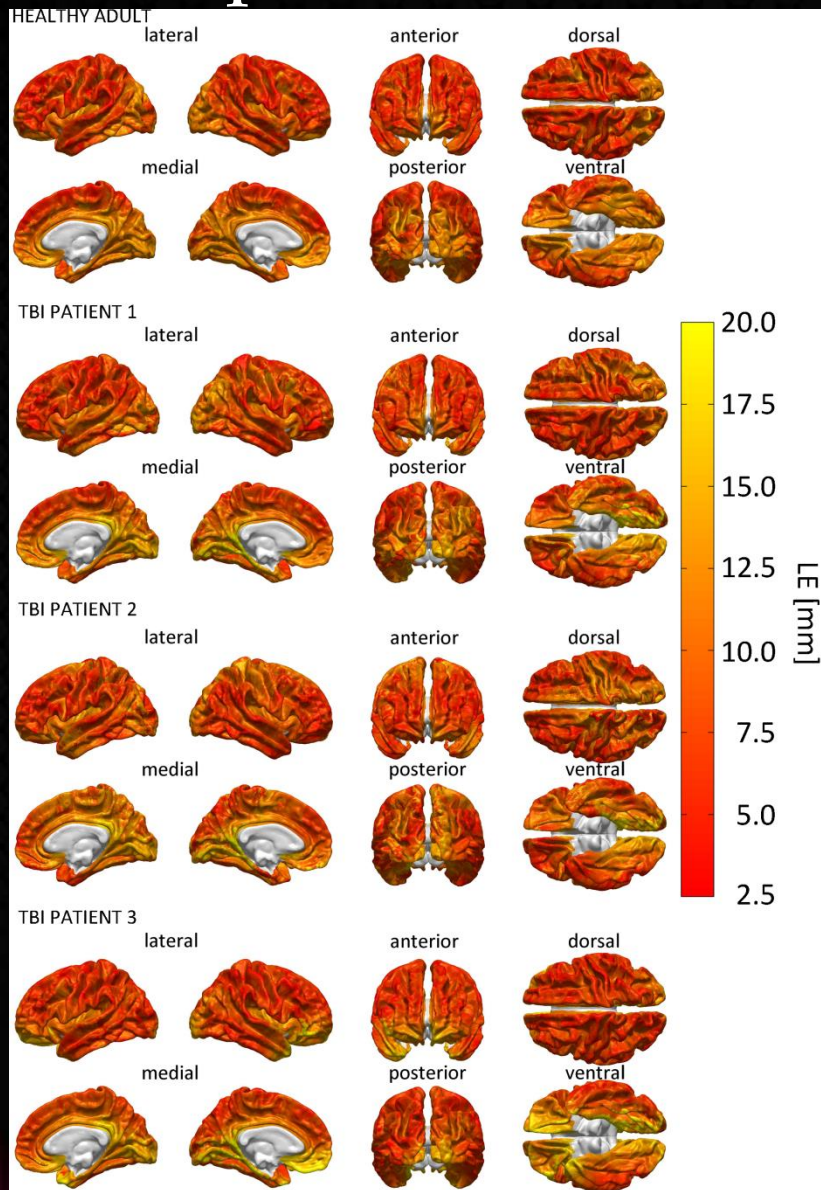
Van Horn *et al.*, (2012) PLoS ONE

Geometric modeling of head tissues via the finite element method (FEM)

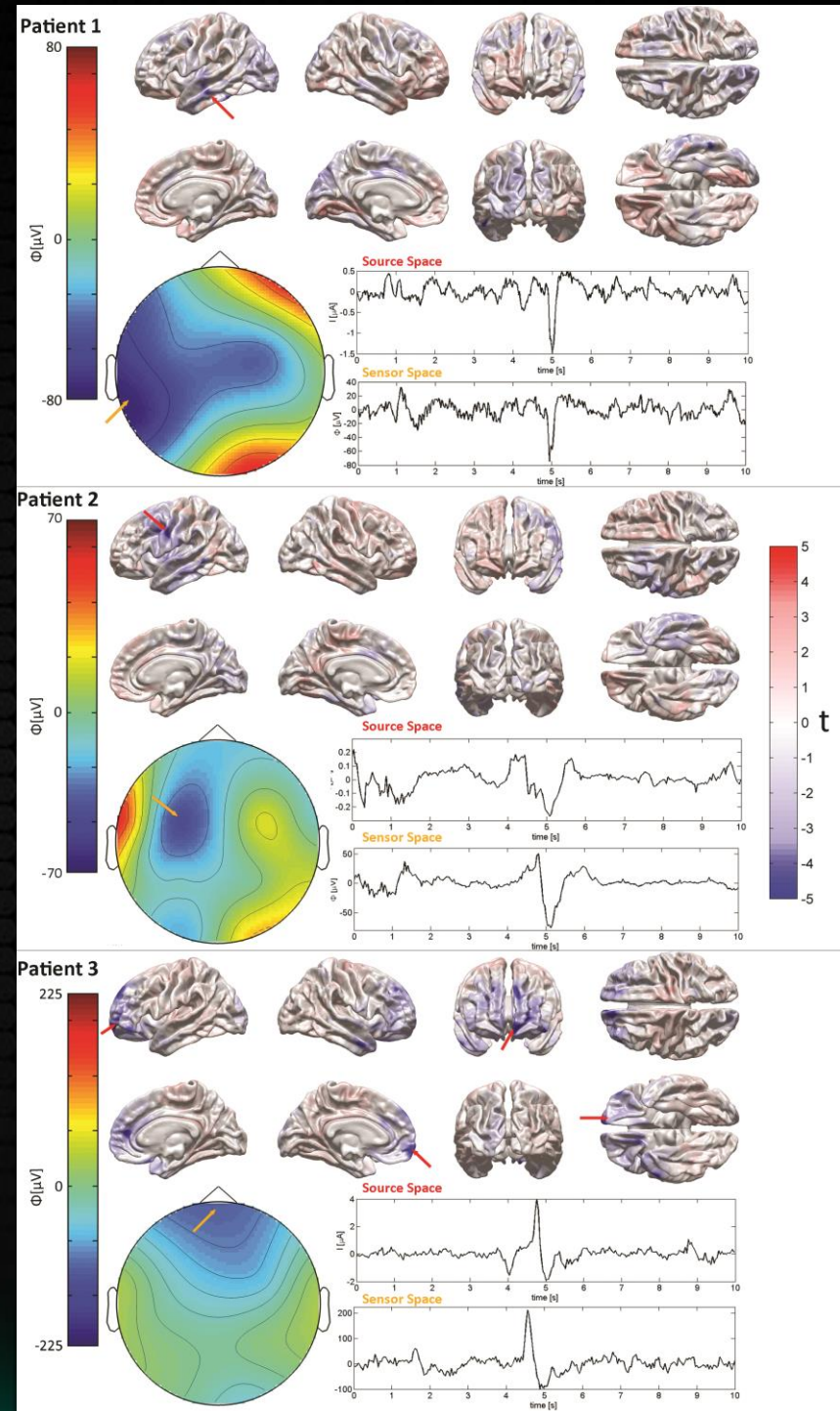


Goh et al. (2013) and Irimia et al. (2012)

EEG inverse localization in the presence of TBI



Goh et al. (2013) and Irimia et al. (2012)



Final Phase NA-MIC DBP Activities

- We are organizing a Slicer dissemination event in February 2014 at USC in collaboration with Sonja Pujol (BWH) to present Slicer functionality to clinicians and translational brain scientists.
- We will interact closely with the group of Marc Niethammer and with Kitware to deliver a CLI module which implements geometric metamorphosis for TBI and which can be integrated into 3D Slicer.
- We will aid our colleagues in the Utah team as they integrating their interactive GrowCut algorithms for TBI lesion segmentation with the ABC algorithm within a 3D Slicer module using a Python script implementation.
- We will develop several Slicer MRB (medical reality bundle) packages which will include TBI sample data sets, tutorials and documentation. These will be uploaded into the MIDAS server of the NA-MIC collaboration via the DataStore feature.
- We will be writing grants, grants, and more grants to continue our innovative research into the characterization of subject specific brain trauma using multi-modal neuroimaging methods

Comparison of Acute and Chronic Traumatic Brain Injury Using Semi-Automatic Multimodal Segmentation of MR Volumes

Andrei Irimia,¹ Micah C. Chambers,^{1,2} Jeffrey R. Alger,^{3–5} Maria Filippou,⁶ Marcel W. Prastawa,^{7,8} Bo Wang,^{7,8} David A. Hovda,³ Guido Gerig,^{7,8} Arthur W. Toga,^{1,4,5} Ron Kikinis,⁹ Paul M. Vespa,⁶ and John D. Van Horn¹

frontiers in
NEUROLOGY

METHODS ARTICLE
published: 06 February 2012
doi: 10.3389/fneur.2012.00010



Patient-tailored connectomics visualization for the assessment of white matter atrophy in traumatic brain injury

Andrei Irimia¹, Micah C. Chambers¹, Carinna M. Torgerson¹, Maria Filippou², David A. Hovda², Jeffrey R. Alger³, Guido Gerig⁴, Arthur W. Toga¹, Paul M. Vespa², Ron Kikinis⁵ and John D. Van Horn^{1*}

¹ Laboratory of Neuro Imaging, Department of Neurology, University of California Los Angeles, Los Angeles, CA, USA
² Brain Injury Research Center, Departments of Neurology and Neurosurgery, University of California Los Angeles, Los Angeles, CA, USA
³ Department of Radiology, David Geffen School of Medicine, University of California Los Angeles, Los Angeles, CA, USA
⁴ Scientific Computing and Imaging Institute, University of Utah, Salt Lake City, UT, USA
⁵ Surgery Planning Laboratory, Department of Radiology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA

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PLOS one

Mapping Connectivity Damage in the Case of Phineas Gage

John Darrell Van Horn^{1*}, Andrei Irimia¹, Carinna M. Torgerson¹, Micah C. Chambers¹, Ron Kikinis², Arthur W. Toga¹

¹ Laboratory of Neuro Imaging (LONI), Department of Neurology, David Geffen School of Medicine, University of California Los Angeles, Los Angeles, California, United States of America, ² Surgical Planning Laboratory, Department of Radiology, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States of America

Brain Imaging and Behavior
DOI 10.1007/s11682-012-9202-3

ORIGINAL RESEARCH

DTI tractography and white matter fiber tract characteristics in euthymic bipolar I patients and healthy control subjects

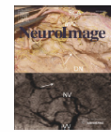
Carinna M. Torgerson · Andrei Irimia · Alex D. Leow ·
George Bartzokis · Teena D. Moody ·
Robin G. Jennings · Jeffrey R. Alger ·
John Darrell Van Horn · Lori L. Altshuler



Contents lists available at SciVerse ScienceDirect

NeuroImage

journal homepage: www.elsevier.com/locate/ynimg



Full Length Article

Circular representation of human cortical networks for subject and population-level connectomic visualization

Andrei Irimia^{*}, Micah C. Chambers, Carinna M. Torgerson, John D. Van Horn

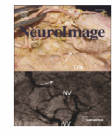
Laboratory of Neuro Imaging, Department of Neurology, David Geffen School of Medicine, University of California, Los Angeles, 635 Charles E Young Drive South, Suite 225, Los Angeles, CA, USA
NeuroImage 59 (2012) 2464–2474



Contents lists available at SciVerse ScienceDirect

NeuroImage

journal homepage: www.elsevier.com/locate/ynimg



Source cancellation profiles of electroencephalography and magnetoencephalography

Andrei Irimia^{a,*}, John Darrell Van Horn^a, Eric Halgren^b

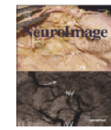
NeuroImage 66 (2013) 489–499



Contents lists available at SciVerse ScienceDirect

NeuroImage

journal homepage: www.elsevier.com/locate/ynimg



The structural, connectomic and network covariance of the human brain

Andrei Irimia^{*}, John D. Van Horn

NeuroImage: Clinical 1 (2012) 1–17



Contents lists available at SciVerse ScienceDirect

NeuroImage: Clinical

journal homepage: www.elsevier.com/locate/ynicl



Neuroimaging of structural pathology and connectomics in traumatic brain injury: Toward personalized outcome prediction[☆]

Andrei Irimia^{a,*}, Bo Wang^b, Stephen R. Aylward^c, Marcel W. Prastawa^b, Danielle F. Pace^c, Guido Gerig^b, David A. Hovda^d, Ron Kikinis^c, Paul M. Vespa^d, John D. Van Horn^a

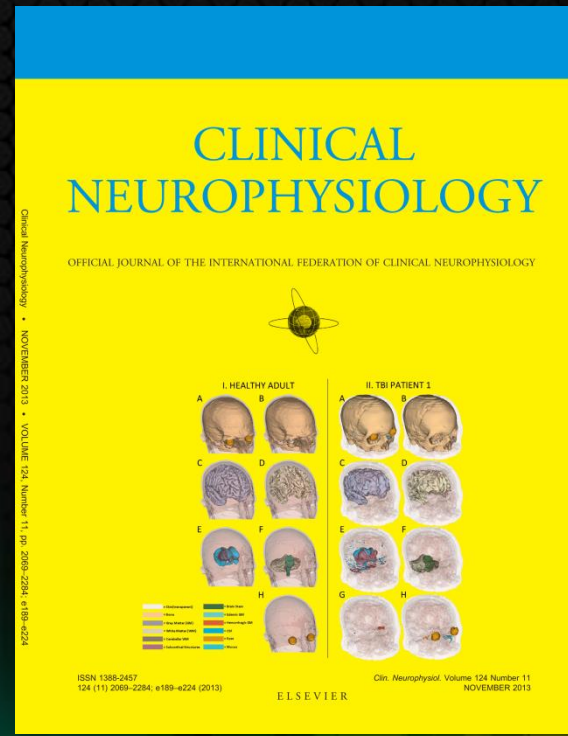
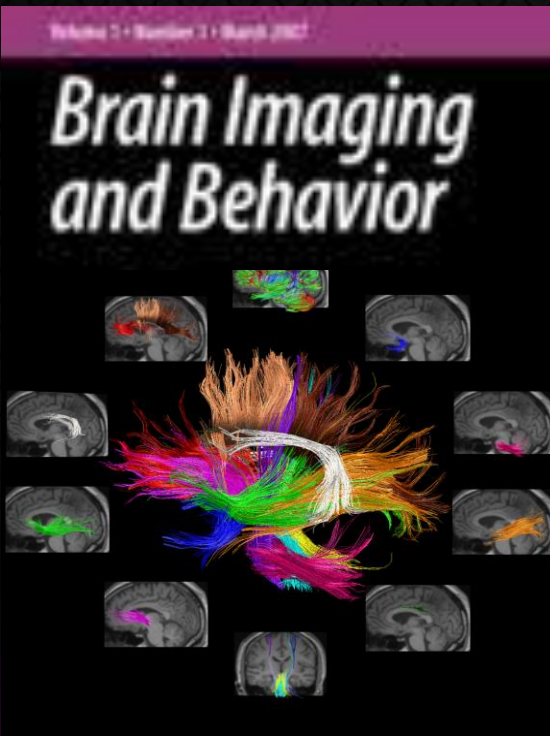
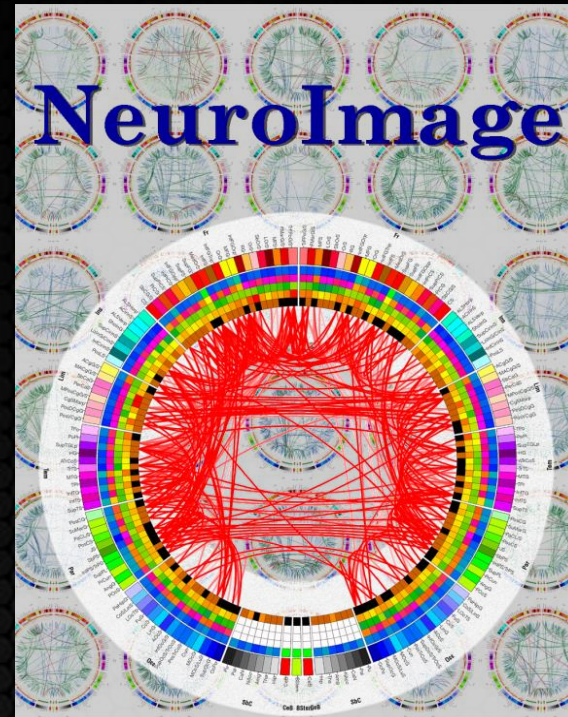
^a Laboratory of Neuro Imaging, Department of Neurology, University of California, Los Angeles, CA 90095, USA

^b Scientific Computing Institute, University of Utah, Salt Lake City, UT 84112, USA

^c Kitware, Inc., Clifton Park, NY 12065, USA

^d Brain Injury Research Center, Department of Neurosurgery, University of California, Los Angeles, CA 90095, USA

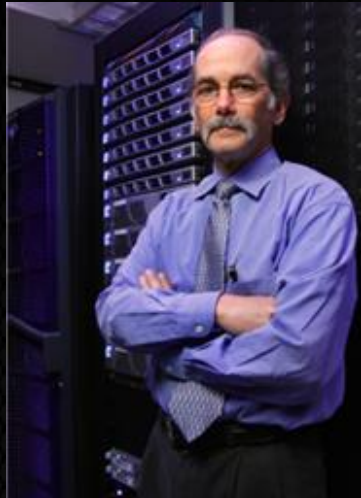
^e Surgical Planning Laboratory, Department of Radiology, Harvard Medical School, Boston, MA 02115, USA



Acknowledgments



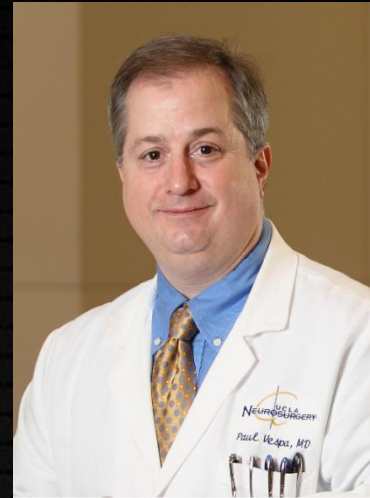
Guido Gerig
Utah



Arthur Toga
USC



Allen Tannenbaum
Stony Brook



Paul Vespa
UCLA



Ron Kikinis
Harvard

- **USC:** Andrei Irimia, Matt Goh, Carinna Torgerson
- **UCLA:** Paul Vespa, David Hovda, Jeffrey Alger
- **Univ. of Utah:** Marcel Prastawa, Bo Wang
- **Harvard:** Sonia Pujol
- **Kitware/UNC:** Stephen Aylward, Marc Niethammer
- **UC Irvine:** Yifei Lou

- **Supported by NIBIB (grant 2U54EB005149)**

<http://www.na-mic.org/Wiki/index.php/DBP3:UCLA>

Thank you Ron and
the NA-MIC Community